Dataset: Profiles of stable isotopes of silicon in silicic acid from the US GEOTRACES EPZT cruise (R/V Thomas G. Thompson TN303) in the Eastern Tropical Pacific from October to December 2013

Project(s): U.S. GEOTRACES East Pacific Zonal Transect (U.S. GEOTRACES EPZT)
GEOTRACES Pacific Section: Resolving Silicon Isotope Anomalies in the Eastern Pacific (GEOTRACES EPZT Silicon Isotope)

Abstract: These data include measurements of the stable isotopes of silicon within seawater, silicic acid expressed in del notation relative the standard NBS28, along the section from Peru to Tahiti conducted by US GEOTRACES. Data were generated in the laboratory of Mark Brzezinski at the University of California, Santa Barbara and in the laboratory of Martin Frank in GEOMAR, Kiel, Germany. Intercalibration was also performed between these same two laboratories. For a complete list of measurements, refer to the supplemental document 'Field_names.pdf', and a full dataset description is included in the supplemental file 'Dataset_description.pdf'. The most current version of this dataset is available at: http://www.bco-dmo.org/dataset/728819

Description: Profiles of stable isotopes of silicon in silicic acid from the US GEOTRACES EPZT cruise

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Acquisition Description: Sampling protocol followed the “Sampling and Handling Protocols for GEOTRACES cruises" (PDF). Also see the "Si Natural Abundance Preparation" procedure (PDF)

Briefly: Water samples were collected with a conventional CTD and rosette as Si isotopes are not contamination prone. Water samples were filtered through a polyethersulfone filter cartridge directly from each sampling bottle using silicon tubing and stored in either high density polyethylene or polypropylene bottles that were pre-cleaned by an overnight soak in 10% ACS grade HCl and rinsed with high purity deionized distilled water (> 18 MΩ - cm) and stored at room temperature.

Analytical methodology followed Brzezinski et al. (2006):
Brzezinski, M. A., J. L. Jones, C. P. Beucher, and M. S. Demarest. 2006. Automated determination of silicon isotope natural abundance by the acid decomposition of cesium hexafluosilicate. Anal. Chem. 78**:** 6109-6114. doi:10.1021/ac0606406

Processing Description: Occasionally samples are too small to obtain a value or are lost due to problems in sample preparation. These are flagged as NEED TO DECIDE. Other flags as per GEOTRACES as follows:

1 - Good: Passed documented required QC tests.
2 - Not evaluated, not available or unknown: Used for data when no QC test performed or the information on quality is not available.
3 - Questionable/suspect: Failed non-critical documented metric or subjective test(s).
4 - Bad: Failed critical documented QC test(s) or as assigned by the data provider.
9 - Missing data: Used as place holder when data are missing.

BCO-DMO Processing:
- modified parameter names to conform with BCO-DMO and GEOTRACES parameter naming conventions;
- joined to BCO-DMO master EPZT events file;
- converted the "Natural_Abundance_Protocol.doc" document to PDF;
- 11-Sept-2018: changed parameter names to comply with GEOTRACES naming conventions.

Additional GEOTRACES Processing:
As was done for the GEOTRACES-NAT data, BCO-DMO added standard US GEOTRACES information, such as the US GEOTRACES event number, to each submitted dataset lacking this information. To accomplish this, BCO-DMO compiled a 'master' dataset composed of the following parameters: cruise_id, EXPOCODE,SECT_ID, STNNBR, CASTNO, GEOTRC_EVENTNO, GEOTRC_SAMPNO, GEOTRC_INSTR, SAMPNO, GF_NO, BTLNBR, BTLNBR_FLAG_W, DATE_START_EVENT, TIME_START_EVENT, ISO_DATETIME_UTC_START_EVENT, EVENT_LAT, EVENT_LON, DEPTH_MIN, DEPTH_MAX, BTL_DATE, BTL_TIME, BTL_ISO_DATETIME_UTC, BTL_LAT, BTL_LON, ODF_CTDPRS, SMDEPTH, FMDEPTH, BTMDEPTH, CTDPRS, CTDDEPTH.

This added information will facilitate subsequent analysis and inter comparison of the datasets.

Bottle parameters in the master file were taken from the GT-C_Bottle and ODF_Bottle datasets. Non-bottle parameters, including those from GeoFish tows, Aerosol sampling, and McLane Pumps, were taken from the TN303 Event Log (version 30 Oct 2014). Where applicable, pump information was taken from the PUMP_Nuts_Sals dataset.

A standardized BCO-DMO method (called "join") was then used to merge the missing parameters to each US GEOTRACES dataset, most often by matching on sample_GEOTRC or on some unique combination of other parameters.

If the master parameters were included in the original data file and the values did

not differ from the master file, the original data columns were retained and the names of the parameters were changed from the PI-submitted names to the standardized master names. If there were differences between the PI-supplied parameter values and those in the master file, both columns were retained. If the original data submission included all of the master parameters, no additional columns were added, but parameter names were modified to match the naming conventions of the master file.

See the dataset parameters documentation for a description of which parameters were supplied by the PI and which were added via the join method.

Project Information

U.S. GEOTRACES East Pacific Zonal Transect

From the NSF Award Abstract The mission of the International GEOTRACES Program (www.geotraces.org), of which the U.S. chemical oceanography research community is a founding member, is "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions" (GEOTRACES Science Plan, 2006). In the United States, ocean chemists are currently in the process of organizing a zonal transect in the eastern tropical South Pacific (ETSP) from Peru to Tahiti as the second cruise of the U.S.GEOTRACES Program. This Pacific section includes a large area characterized by high rates of primary production and particle export in the eastern boundary associated with the Peru Upwelling, a large oxygen minimum zone that is a major global sink for fixed nitrogen, and a large hydrothermal plume arising from the East Pacific Rise. This particular section was selected as a result of open planning workshops in 2007 and 2008, with a final recommendation made by the U.S.GEOTRACES Steering Committee in 2009. It is the first part of a two-stage plan that will include a meridional section of the Pacific from Tahiti to Alaska as a subsequent expedition. This award provides funding for management of the U.S.GEOTRACES Pacific campaign to a team of scientists from the University of Southern California, Old Dominion University, and the Woods Hole Oceanographic Institution. The three co-leaders will provide mission leadership, essential support services, and management structure for acquiring the trace elements and isotopes samples listed as core parameters in the International GEOTRACES Science Plan, plus hydrographic and nutrient data needed by participating investigators. With this support from NSF, the management team will (1) plan and coordinate the 52-day Pacific research cruise described above; (2) obtain representative samples for a wide variety of trace metals of interest using conventional CTD/rosette and GEOTRACES Sampling Systems; (3) acquire conventional JGOFS/WOCE-quality hydrographic data (CTD, transmissometer, fluorometer, oxygen sensor, etc) along with discrete samples for salinity, dissolved oxygen (to 1 uM detection limits), plant pigments, redox tracers such as ammonium

and nitrite, and dissolved nutrients at micro- and nanomolar levels; (4) ensure that proper QA/QC protocols are followed and reported, as well as fulfilling all GEOTRACES Intercalibration protocols; (5) prepare and deliver all hydrographic-type data to the GEOTRACES Data Center (and US data centers); and (6) coordinate cruise communications between all participating investigators, including preparation of a hydrographic report/publication. Broader Impacts: The project is part of an international collaborative program that has forged strong partnerships in the intercalibration and implementation phases that are unprecedented in chemical oceanography. The science product of these collective missions will enhance our ability to understand how to interpret the chemical composition of the ocean, and interpret how climate change will affect ocean chemistry. Partnerships include contributions to the infrastructure of developing nations with overlapping interests in the study area, in this case Peru. There is a strong educational component to the program, with many Ph.D. students carrying out thesis research within the program. Figure 1. The 2013 GEOTRACES EPZT Cruise Track. [click on the image to view a larger version]

GEOTRACES Pacific Section: Resolving Silicon Isotope Anomalies in the Eastern Pacific

NSF Award Abstract: A scientist from the University of California, Santa Barbara will obtain water column samples collected during the 2013 GEOTRACES cruise from Peru to Tahiti. The samples will be analyzed for silicon (Si) isotopes to obtain the first major section of Si isotope distributions in the Pacific Ocean basin. Because the transect covers a large gradient in primary productivity from the upwelling zone off Peru to the oligotrophic subtropical gyre near Tahiti the researcher will determine how Si behaves within high productivity waters relative to oligotrophic waters. Specifically, the hypothesis to be tested is that Si isotope distributions are controlled by fractionation of Si isotopes during silica production and silica dissolution coupled to movement of Si by the biological pump and the meridional overturning circulation. In addition, the scientist plans to collaborate with researchers from Stanford University, the University of Massachusetts, Dartmouth, and Brown University who will measure the stable isotopic composition of nitrate on the same section, to ascertain whether Si and nitrogen isotopes can be used to predict nutrient depletion patterns within the gradient in productivity observed between Peru and Tahiti. The role of Fe in Si dynamics will be evaluated in collaboration with a University of California, Santa Cruz researcher who will measure total [Fe] in surface waters collected during the cruise. Lastly, with the data, the scientist plans to test the prediction capabilities of the PANDORA model, as well as improve the model by incorporating a benthic source of Si in the North Pacific to simulate the inputs of the Northeast Pacific Silicic Acid Plume. As regards broader impacts, one undergraduate student would be supported and trained as part of this project.

Deployment Information

Deployment description for R/V Thomas G. Thompson TN302

Deployment description for R/V Thomas G. Thompson TN303

A zonal transect in the eastern tropical South Pacific (ETSP) from Peru to Tahiti as the second cruise of the U.S.GEOTRACES Program. This Pacific section includes a large area characterized by high rates of primary production and particle export in the eastern boundary associated with the Peru Upwelling, a large oxygen minimum zone that is a major global sink for fixed nitrogen, and a large hydrothermal plume arising from the East Pacific Rise. This particular section was selected as a result of open planning workshops in 2007 and 2008, with a final recommendation made by the U.S.GEOTRACES Steering Committee in 2009. It is the first part of a two-stage plan that will include a meridional section of the Pacific from Tahiti to Alaska as a subsequent expedition. Figure 1. The 2013 GEOTRACES EPZT Cruise Track. [click on the image to view a larger version] Original data are available from the NSF R2R data catalog

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Instrument Information

Instrument	
Description	Water samples are collected with a conventional CTD and rosette as Si isotopes are not contamination prone.
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24 or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Instrument	
Description	IRMS method as per Brzezinski et al., 2006.
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Generic	The Isotope-ratio Mass Spectrometer is a particular type of mass

Instrument Description	spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).